

**STATE OF VERMONT  
PUBLIC SERVICE BOARD**

Petition of Entergy Nuclear Vermont Yankee, LLC )	
and Entergy Nuclear Operations, Inc. for )	
amendment of their Certificate of Public Good and )	
other approvals required under 10 V.S.A. §§ 6501- )	Docket No. 7862
6504 and 30 V.S.A. §§ 231(a), 248 & 254, for )	
authority to continue after March 21, 2012, )	
operation of the Vermont Yankee Nuclear Power )	
Station including storage of spent nuclear fuel )	

**PREFILED TESTIMONY OF  
DAVID L. DEEN  
ON BEHALF OF  
VERMONT NATURAL RESOURCES COUNCIL AND  
CONNECTICUT RIVER WATERSHED COUNCIL**

October 22, 2012

Mr. Deen's testimony will introduce and describe four reports he commissioned for the Connecticut River Watershed Council relating to the measurement of the thermal discharge from Vermont Yankee's facility, the impacts of the discharge on sensitive species in the Connecticut River, and measures that should be required of Entergy with respect to measuring temperature increases resulting from the discharge and mitigating impacts of those increases. Mr. Deen's testimony will also introduce and describe a letter from the Department of Interior, United States Geological Survey that he received in response to inquiries submitted to the USGS regarding American Shad.

## EXHIBITS

- Exhibit DLD-1: Resume of David L. Deen
- Exhibit DLD-2: Review of Vermont Yankee Thermal Discharge Modeling  
HydroAnalysis February 6, 2012
- Exhibit DLD-3: Review of Vermont Yankee Thermal Discharge Permit  
Requirements and Analysis of Connecticut River Water  
Temperature and Flow – HydroAnalysis, August 17, 2012
- Exhibit DLD-4: Selection of Representative Important Species for the Connecticut  
River in the Vicinity of the Vermont Yankee Electric Generating  
Facility – Midwest Biodiversity Institute, February 6, 2012
- Exhibit DLD-5: Development of a Database for Upper Thermal Tolerances for  
New England Freshwater Fish Species – Midwest Biodiversity  
Institute, May 25, 2012
- Exhibit DLD-6: Replies to CRWC Queries Pertaining to Connecticut River  
American Shad – Letter from Department of Interior, United States  
Geological Survey, July 2, 2007
- Exhibit DLD-7: Summary of curriculum vitae of Mr. Hickey, Mr. Homa, Mr.  
Shanahan, and Mr. Yoder

- 1 Q1: Please state your name.
- 2 A1: David L. Deen.
- 3
- 4 Q2: Where do you live and what is your business address?
- 5 A2: I live in Westminster, Vermont. My business address is PO Box 206 Saxtons
- 6 River, VT.
- 7
- 8 Q3: What is the purpose of your testimony?
- 9 A3: The purpose of my testimony, on behalf of the Vermont Natural Resources
- 10 Council (“VNRC”) and the Connecticut River Watershed Council (“CRWC”), is
- 11 to present and describe three reports I commissioned for the CRWC that evaluate

(1) the model used to measure the scope and scale of the thermal discharge from the Vermont Yankee Nuclear Power Station ("VYNPS") by Vermont Yankee Entergy Nuclear, LLC and Entergy Nuclear Operations, Inc. (hereinafter "Entergy"); (2) the accuracy of the measurement of the thermal discharge on the temperature of the Connecticut River (hereinafter "Connecticut River" or "River"); and (3) the fish species selected for measuring the impacts of the thermal discharge on the aquatic species that inhabit the Connecticut River, as well as a supplemental report that presents a database to be used to select fish species for measuring the impacts of thermal discharges on aquatic species that inhabit the River. In addition, the purpose of my testimony is to present and describe a letter that I received from the United States Geological Survey responding to CRWC's inquiries about Connecticut River American Shad (hereinafter "American Shad").

Q4: Please describe your qualifications for testifying about these reports and the letter from the USGS, and about the VYNPS's thermal discharge and its impacts on aquatic species in the Connecticut River.

A4: I have a Masters in Environmental Studies from Antioch University in Keene, New Hampshire (1996). I have worked for the CRWC as a River Steward for the Upper Connecticut River Watershed since 1998. Serving as a River Steward includes advocacy on issues affecting the Connecticut River, and in that role I have extensive experience in evaluating the impacts of thermal discharges on fish species. My experience includes reviewing all NPDES permits proposed or issued since 1998 for discharges to the Connecticut River. With respect to thermal discharges from the VYNPS, I have been involved in advocacy work

1 regarding NPDES permits issued to or applied for by Entergy since 2004. I have  
2 also served as a State Representative in the Vermont General Assembly since  
3 1991. I have chaired the House Fish and Wildlife Committee, and Natural  
4 Resources and Energy Committee, both of which have oversight over the State's  
5 regulation of discharges to surface water and protection of Vermont's aquatic  
6 habitats, for a total of 14 years. I am currently Chair of the Fish, Wildlife and  
7 Water Resources Committee. My resume is attached as Exhibit DLD-1.

8  
9 Q5: Please identify the report that evaluates the model that Entergy uses to determine  
10 the extent of their thermal discharge.

11 A5: The report that evaluates the thermal model that Entergy uses to predict the  
12 effects and spacial distribution of the thermal discharge to the Connecticut River  
13 was prepared by HydroAnalysis, Inc., is titled "Review of Vermont Yankee  
14 Thermal Discharge Modeling," and is dated February 6, 2012 (hereinafter "HA  
15 Model Report"). I commissioned HydroAnalysis to conduct this review in  
16 support of the CRWC's ongoing advocacy for the preservation and restoration of  
17 the Connecticut River, and they presented it to CRWC in February of 2012.  
18 CRWC submitted this report to VNRC in February of 2012 to be filed with the  
19 Public Service Board in this Docket. CRWC possesses a copy of the HA Model  
20 Report in CRWC records that are in my custody. A copy of the HA Model  
21 Report is attached hereto as Exhibit DLD-2.

22  
23 Q6: Please identify the report that evaluates Entergy's measurement of the thermal  
24 discharge from the VYNPS.

1 A6: The report that evaluates the measurement of the thermal discharge from the  
2 VYNPS was prepared by HydroAnalysis, Inc., is titled "Review of Vermont  
3 Yankee Thermal Discharge Permit Requirements and Analysis of Connecticut  
4 River Water Temperature and Flow," and is dated August 17, 2012 (hereinafter  
5 "HA Thermal Report"). I commissioned HydroAnalysis, Inc. to conduct this  
6 review in support of the CRWC's ongoing advocacy for the preservation and  
7 restoration of the Connecticut River, and they submitted it to CRWC on August  
8 17, 2012. CRWC submitted this report to VNRC in September of 2012 to be filed  
9 with the Public Service Board in this Docket. CRWC possesses a copy of the HA  
10 Thermal Report in CRWC records that are in my custody. A copy of the HA  
11 Thermal Report is attached hereto as Exhibit DLD-3.

12  
13 Q7: Why did you select HydroAnalysis to conduct the evaluation and prepare the HA  
14 Model Report and the HA Thermal Report?

15 A7: The principles at HydroAnalysis who prepared the HA Model Report and the HA  
16 Thermal Report have extensive experience in thermodynamics, including  
17 reviewing thermal discharges from power plants regardless of the fuel used to  
18 produce the power, and are highly respected in their field. Ken Hickey, and John  
19 Shanahan, Ph.D, P.E., and John Homa, Jr. of Ichthyological Associates, LLC,  
20 prepared the HA Model Report. Mr. Hickey and Mr. Shanahan prepared the HA  
21 Thermal Report. Mr. Hickey has twenty years of experience conducting surface  
22 water hydrologic and water quality investigations, and has designed and  
23 conducted numerous river and estuarine hydrologic and water quality modeling  
24 studies. He has conducted river studies for the U.S. Environmental Protection  
25 Agency, U. S. Army Corps of Engineers, state agencies and commercial clients

1 throughout New England and the United States. Mr. Shanahan has over thirty-five  
2 years of experience in environmental engineering and consulting, during which he  
3 completed a wide variety of projects involving analysis and computer modeling of  
4 environmental water quality, hydrology and hydraulics. Mr. Shanahan has worked  
5 on issues of waste heat disposal by nuclear power plants and other facilities as a  
6 consulting engineer and academic researcher since 1974. Mr. Homa is President  
7 of Ichthyological Associates, LLC, and has directed studies throughout the  
8 Eastern United States concerning fisheries habitat, fish entrainment/impingement,  
9 fish passage, water temperature monitoring and modeling, and rare species. He  
10 has been a technical member of the negotiation teams for over three dozen  
11 hydroelectric development settlements that have resulted in habitat enhancement  
12 on thousands of acres of reservoirs and hundreds of miles of rivers and streams.  
13 Summaries of the qualifications of Mr. Hikey, Mr. Homa and Mr. Shanahan,  
14 provided with their reports, and that are in CRWC's records which are in my  
15 custody, are attached in Exhibit DLD-5.

16  
17 Q8 Would you please summarize the evaluation and findings of HydroAnalysis in the  
18 HA Model Report.

19 A8 The HA Model Report makes findings that call into question the Demonstration  
20 Model that Entergy used in their 316(a) Demonstration which they conducted and  
21 filed with ANR in 2004. In particular, Entergy's model assumed the thermal  
22 plume from the VYNPS was 0.5 miles long, when in 1978 the owners of the  
23 VYNPS had demonstrated a greater than 1° F temperature increase 55 miles  
24 downstream in Holyoke. In addition, the model was run in a steady-state mode,  
25 despite being designed to evaluate a wide range of dynamic scenarios. The model

1 used only 10 steady-state scenarios using only 16% of available temperature data,  
2 which did not adequately describe the full range of possible operating and  
3 ambient conditions of low flow and high temperatures. In sum, the HA Model  
4 Report concludes that Entergy's model fails to adequately characterize the  
5 impacts of the VYNPS's thermal discharge into the Connecticut, including  
6 impacts on fish species in the River.

7  
8 Q9: Would you please summarize the evaluation and findings of HydroAnalysis in the  
9 HA Thermal Report?

10 A9: HydroAnalysis analyzes the methodology, as set forth in an equation (Equation  
11 1.1) in the last NDPS permit issued to Entergy, used for measuring the increase  
12 in temperature of the Connecticut River between measuring stations located  
13 upstream and downstream of VYNPS. HydroAnalysis relied on continuously-  
14 recorded data for five years from 2006 through 2010 from Entergy and from the  
15 United States Fish and Wildlife Service for its review data. The majority of the  
16 data from 2006 through 2010 was collected after ANR issued an amended  
17 NPDES permit to Entergy in March of 2006.

18  
19 Among other findings, the HA Thermal Report found that the use of Equation 1.1  
20 to compute the temperature rise as a surrogate for the actual temperature rise  
21 measurements has resulted in temperature increases below the VYNPS far greater  
22 than those specified in the permit, and "[o]n most days, actual water temperature  
23 rises...at downstream Station 3 and at the fishway exceed the permitted  
24 temperature rise, often by several degrees Fahrenheit and for extended periods of  
25 time." (Exhibit DLD-3 at 14). In sum, the HA Thermal Report shows that (1) the

1 use of Equation 1.1 does not accurately reflect actual temperature increases of  
2 water in the River downstream of the VYNPS thermal discharge, and (2)  
3 Equation 1.1 often indicates compliance with the specified limits on temperature  
4 increases in the NPDES permit when actual temperature increases measured in  
5 the River are substantially higher. To the extent that limits on temperature  
6 increases in the NPDES permit were put in place to protect fish species that  
7 inhabit the River, the HA Thermal Report shows that Equation 1.1 often does not  
8 result in an accurate picture that actual temperature increases in the river stay  
9 below the permit limits. In addition, the HA Thermal Report reports that Entergy  
10 has not submitted heat rejection rate data that it uses in Equation 1.1. Finally, the  
11 HA Thermal Report explains that Equation 1.1 is inappropriate because it uses a  
12 steady-state formula that assumes complete mixing of the thermal discharge, a  
13 condition that does not routinely happen given the variability of the River's flow  
14 and heat output from the plant.

15  
16 Q10: What does the HA Thermal Report recommend?

17 A10: Based on the findings summarized in A10 and other findings, the HA Thermal  
18 Report recommends that Equation 1.1 be replaced with a more accurate and  
19 protective approach for measuring the temperature increase in the River  
20 downstream of the VYNPS's thermal discharge. (Exhibit DLD-3 at 14).

21  
22 Q11: Please identify the reports that evaluate Entergy's selection of species for  
23 measuring the impacts of the thermal discharge on aquatic species that inhabit the  
24 Connecticut River.



1 A11: Two reports that evaluate Entergy's selection of species for measuring the  
2 impacts of the thermal discharge on aquatic species that inhabit the Connecticut  
3 River were prepared by Midwest Biodiversity Institute ("MBI").  
4

5 The first report from MBI is titled "Selection of Representative Important Species  
6 for the Connecticut River in the Vicinity of the Vermont Yankee Electric  
7 Generating Facility," and is dated February 6, 2012 (hereinafter "MBI RIS  
8 Report"). I commissioned MBI to conduct this review in support of the CRWC's  
9 ongoing advocacy for the preservation and restoration of the Connecticut River,  
10 and they submitted it to CRWC on February 6, 2012. CRWC submitted this report  
11 to VNRC in February of 2012 to be filed with the Public Service Board in this  
12 Docket. CRWC possesses a copy of the MBI RIS Report in CRWC records that  
13 are in my custody. A copy of the MBI RIS Report is attached hereto as Exhibit  
14 DLD-4.  
15

16 The second report from MBI is titled "Development of a Database for Upper  
17 Thermal Tolerances for New England Freshwater Fish Species," and is dated May  
18 25, 2010 (hereinafter "MBI Database Report"). I commissioned MBI to conduct  
19 this review in support of the CRWC's ongoing advocacy for the preservation and  
20 restoration of the Connecticut River, and they submitted it to CRWC on February  
21 6, 2012. CRWC submitted this report to VNRC in September of 2012 to be filed  
22 with the Public Service Board in this Docket. CRWC possesses a copy of the  
23 MBI Database Report in CRWC records that are in my custody. A copy of the  
24 MBI Database Report is attached hereto as Exhibit DLD-5.  
25

1 Q12: Why did you select MBI to conduct the evaluation and prepare the MBI RIS  
2 Report and the MBI Database Report?

3 A12: Chris Yoder, Principal Investigator with MBI and the author of the MBI Report,  
4 has extensive experience in determining and selecting of Representative  
5 Important Species ("RIS") and using them in 316(a) demonstrations. Mr. Yoder  
6 is research Director of the Center for Applied Bioassessment and Biocriteria at the  
7 Midwest Biodiversity Institute. His primary areas of expertise include fish  
8 distribution, ecology, and taxonomy, water quality, and monitoring and  
9 assessment design and execution. In addition, he conducted a fish species  
10 analysis for all species in the Connecticut River. His investigation, done for EPA  
11 in 2008, was conducted along the entire length of the river from Canada to Long  
12 Island Sound. His is the only such study done on the entire length of the river. A  
13 summary of the qualifications of Mr. Yoder is included in Exhibit DLD-7.

14

15 Q13: Would you please summarize the evaluation and findings of MBI in the MBI RIS  
16 Report?

17 A13: MBI analyzes the methodology for selecting RIS for 31(a) demonstrations  
18 submitted by Entergy to the Vermont Agency of Natural Resources pursuant to  
19 the Clean Water Act. In particular, Mr. Yoder identifies two aspects of RIS  
20 analysis that are vital to an accurate RIS: the extent of the "study area", and, how  
21 the RIS will be used to either evaluate thermal impacts and/or establish a  
22 protective thermal regime. In both of these focuses, Yoder lays out an approach  
23 he developed (Fish Temperature Modeling System – or "FTMS" – methodology  
24 of Yoder) and that was used for other rivers such as the Ohio and the Lower  
25 Desplaines River, and applies this method to the River. In addition, in an

1 appendix to the original study MBI sets out a possible method to select a more  
2 representative species selection.

3  
4 The MBI RIS Report finds that the RIS for the Connecticut River does not include  
5 all fish species needed to evaluate the impacts of the thermal discharge on aquatic  
6 species in the river. In particular, using the FTMS approach, which evaluated  
7 species data collected in 2008, Yoder found that ANR should further study  
8 whether the RIS should be expanded to include those species that may have a  
9 more acute sensitivity to thermal pollution than the RIS selected in 2004 by  
10 Normandeau. Yoder concludes that the 2004 RIS largely restricted RIS  
11 determinations to only the most commonly occurring and therefore the most  
12 tolerant species, and excluded the thermally sensitive and intolerant species, even  
13 though the original EPA guidelines for 316(a) determinations provide for  
14 including such species.

15  
16 Q14: What does the MBI RIS Report recommend?

17 A14: Based on its findings, the MBI RIS Report provides a list of potential additions of  
18 species to the RIS so that it would be more in line with the original EPA  
19 guidelines, as well as more modern science, for 316(a) determinations provided  
20 for including such species.

21  
22 Q15: Would you please summarize and explain the MBI Database Report and the  
23 purpose of the database it presents?

24 A15: The Database Report presents a database that can be used with the Fish  
25 Temperature Model to evaluate thermal impacts to fish in a specific site in a river

1 or on a river reach basis in a Fish Thermal Model developed by the author of the  
2 report. It can also be used to develop seasonal temperature criteria for specific  
3 water bodies or river basin areas. In this report the database is used to evaluate  
4 existing and proposed thermal criteria for the Connecticut River mainstem. The  
5 result of this evaluation is Appendix Table 1, which will serve as the thermal  
6 effects database for the purposes of using the Fish Thermal Model described in  
7 the MBI RIS Report. The MBI RIS Report looks at four thermal parameters for  
8 each representative fish species: a physiological or behavioral optimum  
9 temperature, a maximum weekly average temperature for growth, an upper  
10 avoidance temperature, and an upper lethal temperature. In sum, the Fish  
11 Temperature Model presented in the MBI RIS Report and the database in the MBI  
12 Database Report provide biologists who are assessing the impacts of thermal  
13 discharges in the Connecticut River with a tool for determining the overall  
14 thermal tolerance of species in the River.

15  
16 Q16: Please identify the letter that responds to CRWC's inquiries about American  
17 Shad.

18 A16: I received the letter dated July 2, 2007 from Stephen P. Garabedian, Ph.D., of the  
19 United States Geological Survey's Silvio O. Conte Anadromous Fish Research  
20 Laboratory in Turner's Falls, Massachusetts, in response to twelve questions  
21 about American Shad submitted by CRWC (hereinafter "USGS Letter"). I  
22 submitted the inquiries in May of 2007 to obtain information to support CRWC's  
23 ongoing advocacy for the preservation and restoration of the Connecticut River,  
24 and received the letter with replies to CRWC's inquiries on July 2, 2007. The  
25 replies were authored by Dr. Theodore Castro-Santos and Dr. Alexander Haro,

1 Research Fisheries Biologists at the Conte Laboratory. CRWC possesses a copy  
2 of the USGS Letter in CRWC records that are in my custody. CRWC submitted  
3 this letter to VNRC in February of 2012 to be filed with the Public Service Board  
4 in this Docket. A copy of the USGS Letter is attached hereto as Exhibit DLD-6.  
5

6 Q17: Please describe the USGS's response in the USGS Letter to CRWC's inquiries  
7 about American Shad.

8 A17: The letter responds to questions about the population of American Shad and  
9 various environmental factors that may influence trends in their population and  
10 their migration and spawning patterns. In addition, the letter responds to  
11 questions about whether additional studies are needed to assess whether the  
12 VYNPS thermal discharge is having an effect on shad passage at Turner's Falls  
13 Dam, and describes some studies that the USGS would consider useful.  
14

15 Q18: Would you please explain why you presented and described the reports and letter  
16 that you have discussed in your testimony for this Docket?

17 A18: The HA Model Report, the HA Thermal Report, and the USGS Letter contain and  
18 present evidence that Entergy has not adequately demonstrated, as is required by  
19 30 V.S.A. § 248(b)(5), that temperature increases in the Connecticut River  
20 resulting from the VYNPS thermal discharge will not have an undue adverse  
21 effect on the water purity of the River. The MBI RIS Report and the MBI  
22 Database Report contain and present evidence that Entergy has not adequately  
23 demonstrated, as is required by 30 V.S.A. § 248(b)(5), that the VYNPS thermal  
24 discharge will not have an undue adverse effect on aquatic species that are part of  
25 the natural environment of the Connecticut River.

- 1 Q19: Does this conclude your testimony at this time?
- 2 Q19: Yes, it does.